

CLAIMS

1. A bottom-emitting OLED device, comprising:
 - a) a transparent substrate;
 - b) a reflective, semitransparent, and conductive anode layer
 - 5 including a metal or metal alloy or both formed over the substrate;
 - c) a plurality of hole-injecting layers disposed over the reflective, semitransparent and conductive anode layer, including a bilayer structure having a layer including an oxide and a layer including a fluorinated carbon;
 - 10 d) a plurality of organic layers formed over the plurality of the hole-injecting layer and including an emissive layer having electroluminescent material;
 - e) a reflective, opaque and conductive cathode including a metal or metal alloy or both provided over the plurality of organic layers; and
 - 15 f) the plurality of the hole-injecting layers being configured to reduce the drive voltage, and the transparency of the anode and the reflectivity of the cathode, and the thickness of the organic layers between the electrodes being selected to change the internal reflection of light to thereby improve the emission through-substrate.
- 20 2. The bottom-emitting OLED device of claim 1 wherein the plurality of the hole-injecting layers includes an oxide and a fluorinated carbon layer.
3. The plurality of the hole-injecting layers of claim 2 wherein the oxide layer is in contact with the anode and the fluorinated carbon layer, and
- 25 the fluorinated carbon layer is in contact with the oxide and the hole-transport layer.
4. The bottom-emitting OLED device of claim 1 wherein the plurality of organic layers includes a hole-transport layer disposed between the fluorinated carbon layer and the emissive layer.
- 30 5. The bottom-emitting OLED device of claim 1 wherein the plurality of organic layers includes an electron-transport layer disposed between the emissive layer and the cathode.

6. The bottom-emitting OLED device of claim 1 which further includes a transmission enhancement layer (TEL) disposed between the transparent substrate and the reflective, semitransparent, and conductive anode layer to further improve the amount of light which passes through the substrate.
- 5 7. The bottom-emitting OLED device of claim 1 wherein the reflective, semitransparent, and conductive anode includes Ag, Al, Mg, Zn, Rh, Ru, Ir, Au, Cu, Pd, Ni, Cr, Pt, Co, Te, or Mo or alloys or mixtures thereof.
8. The bottom-emitting OLED device of claim 1 wherein the reflective, semitransparent, and conductive anode layer has an absorbance of 30% or less over visible wavelengths (put in spec).
- 10 9. The bottom-emitting OLED device of claim 1 wherein the reflective and conductive cathode includes metal or metal alloys having a work function selected to be about 4.0 eV or less.
10. The bottom-emitting OLED device of claim 9 wherein the metal or metal alloys include alloys of Ag or Al with Mg, alkali metals, alkali earth metals, or Mn.
- 15 11. The bottom-emitting OLED device of claim 1 wherein the oxide layer includes ITO, IZO, Pr_2O_3 , TeO_2 , SiO_2 , VO_x , or MoO_x , or mixtures thereof wherein x is less than 3
- 20 12. The bottom-emitting OLED device of claim 1 wherein the fluorinated carbon layer includes hole-injecting structures including CF_x wherein x is less than 3 and greater than 0.
13. The bottom-emitting OLED device of claim 6 wherein TEL includes ITO, MgO, MoO_x , SnO_2 , TiO_2 , Al_2O_3 , SiO_2 , ZnO, ZrO_2 , Alq, NPB, SiN, AlN, TiN, SiC, or Al_4C_3 , or mixtures thereof.
- 25 14. The bottom-emitting OLED device of claim 6 wherein the thickness of the TEL ranges from 20 nm to 150 nm.
15. The bottom-emitting OLED device of claim 1 wherein the combined thickness of all layers between the anode and cathode is in the range of 60 nm to 180 nm or 220 nm to 330 nm.
- 30 16. The bottom-emitting OLED device of claim 1 wherein the hole transport layer includes NPB.

17. The bottom-emitting OLED device of claim 1 wherein the emissive layer includes Alq.

18. The bottom-emitting OLED device of claim 1 wherein the electron-transport layer includes Alq.

5 19. The bottom-emitting OLED device of claim 1 wherein the emissive layer contains fluorescent or phosphorescent dopants.

20. The bottom-emitting OLED device of claim 1 wherein the thickness of the hole-transport layer is in the range of 20 nm to 80 nm or 180 nm to 230 nm.

10 21. The bottom-emitting OLED device of claim 1 wherein the thickness of the anode layer is in a range of from 4 nm to 50 nm.

22. The bottom-emitting OLED device of claim 1 wherein the thickness of the cathode layer is in a range of from 50 nm to 500 nm.